QuickRoute

Operational Field Assessment Report

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FOREWORD

The National Urban Security Technology Laboratory (NUSTL) is a federal laboratory organized within the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T). Located in New York City, NUSTL is the only national laboratory focused exclusively on supporting the capabilities of state and local first responders to address the homeland security mission. The laboratory provides first responders with the necessary services, products, and tools to prevent, protect against, mitigate, respond to, and recover from homeland security threats and events.

DHS S&T works closely with the nation's emergency response community to identify and prioritize mission capability gaps, and to facilitate the rapid development of critical solutions to address responders' everyday technology needs. DHS S&T gathers input from local, tribal, territorial, state, and federal first responders, and engages them in all stages of research and development—from building prototypes to operational testing to transitioning tools that enhance safety and performance in the field—with the goal of advancing technologies that address mission capability gaps in a rapid time frame, and then promoting quick transition of these technologies to the commercial marketplace for use by the nation's first responder community.

As projects near completion, NUSTL conducts an operational field assessment (OFA) of the technology's capabilities and operational suitability to verify and document that project goals were achieved. NUSTL's OFA reports are posted on the First Responder Communities of Practice website—a professional networking, collaboration, and communication platform created by DHS S&T to support improved collaboration and information sharing amongst the nation's first responders. This vetted community of members focuses on emergency preparedness, response, recovery and other homeland security issues. To request an account, complete the online form on communities.firstresponder.gov/web/guest/home.

Publicly released OFA reports are available at www.dhs.gov/science-and-technology/frg-publications.

Visit the DHS S&T website, www.dhs.gov\science-and-technology\first-responder-technologies, for information on other projects relevant to first responders.

Visit the NUSTL website, www.dhs.gov/science-and-technology/national-urban-security-technology-laboratory, for more information on NUSTL programs and projects.

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EXECUTIVE SUMMARY

First responders often use commercially available navigation software applications (apps) such as Google Maps or Waze when responding to emergency situations. However, these commercially available vehicle routing technologies abide by the public rules of the road, which first responders may not be subject to. By using the same apps as the general public, first responders are not able to use alternate routes that could allow for quicker response to an incident, such as using express lanes, travelling an alternate direction down a one-way road, or using emergency access roads.

To provide responders with an option for more efficient routes, which take into account their unique considerations during an emergency response, the U.S. Department of Homeland Security's (DHS) Science and Technology Directorate (S&T) awarded a contract to Azimuth1, LLC, to develop QuickRoute—a mobile app that would enable responders to take the most efficient route available to them when responding in an emergency situation. This technology leverages existing navigation platforms and databases, while customizing options for first responders in order to calculate the most effective routes for emergency vehicles. It provides route customization according to vehicle type and allows users to enter hazard alerts to denote temporary obstacles (alerts are entered into the app by users as they come across situations such as flooding, accidents, hazards, or road repair, and can be confirmed or cleared as the situation changes.)

The National Urban Security Technology Laboratory (NUSTL) conducted an operational field assessment (OFA) of QuickRoute on April 10, 2019, at a DHS law enforcement facility in Laurel, Maryland, to evaluate the technology's suitability for use by first responders. Six evaluators with backgrounds in communications, fire services and emergency medical services tested the app in various operational scenarios and provided feedback on its functionality, reliability, usability, routing, and hazard alert features.

The evaluators had a range of opinions on the functionality and reliability of QuickRoute, part of which could be attributed to connectivity issues at the site and lack of map data available for the site within the app. All evaluators noted the app should be integrated with jurisdictional dispatch systems, and have audible and visual warnings when instructed to disobey civilian traffic laws.

The evaluators stated that QuickRoute usability could be improved if fewer actions were necessary to carry out app functions. Most evaluators felt that the font size should be increased and the way the map is viewed should be customizable. Routing was impeded when QuickRoute could not determine the direction a vehicle was facing, suggesting turnarounds that would add travel time, especially for large vehicles, when rerouting vehicles by U-turns. Evaluators additionally noted that it would be useful for the app to have voice activated routing and computer-aided dispatch integration to make it easier for responders to quickly enter a response location during emergencies.

While evaluators had some recommendations on how to improve the app's hazard and alert notification capabilities, they found the process of entering, confirming, and clearing alerts was generally easy and intuitive. Despite latency issues with the app's navigational capabilities evaluators felt that they could respond more efficiently to an incident site while using QuickRoute's emergency vehicle routing compared to civilian vehicle routing.

Ultimately, evaluators found that QuickRoute would help them arrive at incident scenes more efficiently if the deficiencies pointed out during the OFA were corrected.

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1.0 INTRODUCTION

Computer-aided dispatch (CAD) systems are used by public safety agencies to assign appropriate emergency response units (i.e., fire service, law enforcement, emergency medical services) to incidents as they occur. Vehicle-mounted route mapping systems are typically available for the assigned responders to navigate to incidents; these systems may not have current, up-to-date mapping data. Discussions at the 2016 First Responder Resource Group meeting found that many first responders use commercially available navigational software applications (apps) such as Google Maps or Waze on their cell phones to route themselves to incidents that they are dispatched to instead of their existing vehicle-mounted systems because of the ease of use, availability, and the greater frequency of map updates on the cell phone apps. These commercially available street routing systems abide by the public rules of the road, which first responders are not subject to. By using the same apps as the general public, first responders are not presented with alternate routes (e.g., accessing private property, express lanes, emergency access roads, driving in the opposite direction down a one-way road) that could facilitate a quicker response time. In addition, an emergency vehicle's response may be limited by its size, weight, and turning radius.

To address these issues and improve responder vehicle navigation, the U.S. Department of Homeland Security's (DHS) Science and Technology Directorate (S&T) awarded a contract to Azimuth1, LLC, to develop QuickRoute—a mobile app designed to enable responders to take the most efficient route uniquely available to them when responding in an emergency situation. This technology is intended to leverage existing platforms and databases, while customizing options for first responders by calculating the best routing for emergency vehicles.

The National Urban Security Technology Laboratory (NUSTL) was tasked with conducting an operational field assessment (OFA) to evaluate the technology's suitability for use by first responders. This OFA report describes responder feedback obtained during the operational test activities that simulated conditions first responders may encounter when responding to an emergency situation.

1.1 Purpose

The purpose of the OFA was to assess QuickRoute's operational suitability for responders in a simulated operational environment.

1.2 Objectives

The OFA assessed:

- Effectiveness of alternate, non-traditional routes such that responders arrive more quickly than with their previous navigation method;
- Ability to quickly route responders while taking into account limiting characteristics of emergency vehicles, as well as their ability to modify local travel restrictions;
- Effectiveness of hazard alert features (ease of entering and removing);
- Compatibility of QuickRoute with iOS and Android mobile devices; and
- Usability while responding to emergency situations (ease of use, ability to compare provided route with an alternate route).

1.3 PARTICIPANTS

Table 1-1 lists the OFA participants. Six evaluators from five different agencies participated, along with assessment team members, the technology developer, and observers.

Table 1-1 OFA Participants

Role	Organization
Evaluators	• Central Islip/Hauppauge Volunteer Ambulance Corps (New York) • Loudoun County Fire and Rescue (Virginia) • Montgomery County Fire and Rescue Service (Maryland) • Silver Spring Volunteer Fire Department (Maryland) • Springfield Emergency Communications (Massachusetts)
Venue Host	DHS Federal law enforcement training facility
Program Managers and Support Staff	DHS S&T
OFA Test Director and Data Collectors	DHS S&T NUSTL
Technology Developer	Azimuth1, LLC
Observers	Maryland Department of Transportation, State Highway Administration
Photographer and Videographer	DHS S&T Communications and Outreach Division

1.4 REQUIREMENTS

Table 1-2 summarizes the requirements that the QuickRoute app was expected to achieve and the way in which those requirements were tested during the OFA. These requirements were drawn from the *First Responder Routing Logic Guide Statement of Objectives* document (U.S. Department of Homeland Security, Science and Technology Directorate, April 24, 2017) and the *QuickRoute: First Responder Emergency Vehicle Routing Project Management Plan* (U.S. Department of Homeland Security, Science and Technology Directorate, May 24, 2018), both of which identify critical capabilities for optimal app functionality.

Figure 1-1 Participating Evaluator and Observer Organizational Logos

Table 1-2 QuickRoute Requirements and Activities Matrix

Requirement	Test Method
Capable of working on a mobile device (i.e., iOS and Android cell phones or tablets)	App usability on iOS and Android devices
Allow for hands-free operations	• Integration with navigation systems hardwired to vehicles • Voice controls
Route effectively using alternate routing rules. Provide automatic updates of new routes, including non-traditional routes responders can take, and associated risks with using any of these alternate routes	Routing scenarios to simulate emergency vehicle responses: • Entering via an exit ramp • Driving the wrong way down a one-way road • Navigating through obstacles (i.e., debris in the road, accidents, barriers) • Crossing road dividers
Alternate mapping should account for emergency vehicle size and weight	Familiarization session review and verification during operational scenarios
Notification of road and/or weather conditions that hamper timely response	Simulated a lane closure and flooded roadway alerts
Ability to toggle system to turn certain features on/off per jurisdiction (allow users to configure)	Familiarization session
Usage reports show route selection and efficiency statistics	After-action review interface
Users can confirm and clear reported alerts	Routing scenarios
Identified hazards are communicated to other nearby users	Inject simulated hazard alerts during routing scenarios
Identified hazards automatically modify routing rules and paths	Routing scenarios

1.5 System Description

QuickRoute is a real-time routing and navigation tool designed to aid first responders in finding the most efficient route uniquely available to them when responding to an emergency situation.

The system is comprised of a server component and a mobile app (see Figure 1-2), available on iOS and Android platforms that can be run on mobile devices and mobile data computers mounted in vehicles. QuickRoute's system architecture is designed for the app to communicate directly with backend mapping and routing services provided by Amazon Web Services in-memory databases.

The system leverages existing platforms and databases, while customizing options for emergency response needs by calculating the best routing option for emergency vehicles based on road conditions as well as vehicle size and capabilities. The app also has the ability to factor in traffic patterns and local jurisdiction rules. Route optimization takes into account responder and emergency vehicle-specific factors, including:

- Emergency driving rules afforded to law enforcement, fire, and emergency medical services vehicles;
- Department-level protocols for handling vehicle usage; and
- Vehicle characteristics: size (length and width) and weight restrictions, turning radius of emergency response vehicles.

Figure 1-2 QuickRoute Navigation Display
Courtesy of Azimuth1, LLC

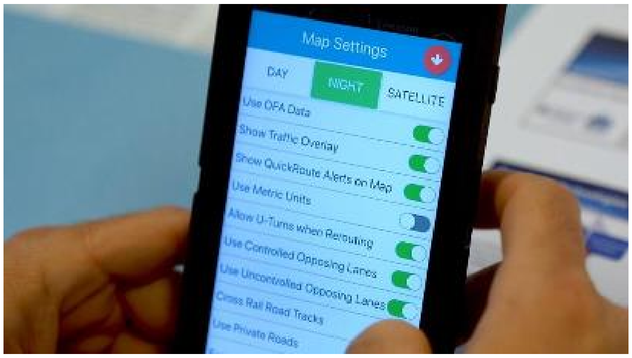

Figure 1-3 Modifying QuickRoute's Map Settings

Figure 1-4 Vehicle Selection Options

QuickRoute allows the user to enter alerts in the app, which in turn alter the routes of other users to avoid hazardous areas. Various types of alerts that affect travel through an area can be entered in the app, including accident, hazard, road repair, and flooding alerts. A user has the ability to enter a new alert and to confirm or clear an existing alert; if an alert is not cleared or confirmed within a two-hour window, it is automatically removed from the map.

In addition, QuickRoute generates usage reports, which provide information about time savings, advantages and disadvantages of chosen routes, and whether the routes were viable and should be available for future use.

2.0 OPERATIONAL FIELD ASSESSMENT DESIGN

2.1 Event Design

During this OFA, six responders from communications, fire services, and emergency medical service disciplines in Maryland, Massachusetts, New York, and Virginia served as evaluators to assess the functionality, capability, and usability of QuickRoute in simulated response scenarios. The OFA was conducted at a DHS Federal law enforcement training facility in Laurel, Maryland, where evaluators participated in various activities using the QuickRoute app on iPad tablets in a classroom and while driving a response vehicle in three simulated incident response circuits. One evaluator also used his iPhone during the circuits. Evaluators were grouped into three pairs and a data collector from NUSTL was assigned to each pair and rode along in the response vehicle. The data collectors facilitated the test activities, recorded observations and comments during each activity, and used a questionnaire to gather feedback from each evaluator following the completion of all activities at each circuit. Following the completion of the three circuits, a group debrief was held to solicit additional feedback from the evaluators. Observers from federal and state agencies watched the OFA activities and provided feedback during the group debrief session.

2.2 Scope

The OFA consisted of the following components:

<u>Classroom Presentation and Technology Familiarization</u>

The OFA began with an introductory session providing participants with an overview of the OFA process, how the capability gap was identified, planned activities for the OFA, and a site safety briefing. Azimuth1 provided an overview of QuickRoute in the classroom, which included background on the development of the technology and a technology familiarization session. During this session, evaluators were able to use the app on provided iPad tablets while Azimuth1 guided them through vehicle type selection, possible emergency rule modifications, and alert management.

Figure 2-1 First Responders Utilizing QuickRoute during the Technology Familiarization Session

<u>Assessment Activities</u>

After the familiarization session, the evaluators performed the activities listed in Table 2-1, with the three teams driving on different circuits simultaneously while the Azmuth1 developer simulated a dispatcher and communicated with the vehicles by radio. After completing the activities for each circuit, they provided direct feedback in response to questions from NUSTL data collectors. NUSTL data collectors also noted any candid feedback and comments during the activities. Full details of the event design are described in the QuickRoute Operational Field Assessment Plan (U.S. Department of Homeland Security (DHS), Science and Technology Directorate, March 2019).

Table 2-1 Assessment Activities

Activity Title	Activity Description	Purpose
Circuit A Fire Response	Evaluators customized their settings to navigate as an emergency truck and navigate to a simulated fire.	Assess the app's ability to perform point-to-point routing, automatically reroute, confirm user-generated alerts, and enter an alert.
Circuit B Accident Response	Evaluators customized their settings to navigate as an emergency vehicle and navigate to a simulated accident.	Assess the app's ability to perform point-to-point routing, automatic rerouting, confirm alerts, navigate to a manually selected destination, and enter a roadway in reverse direction up an exit ramp.
Circuit C Medical Response	Evaluators customized their settings to navigate as an emergency vehicle and navigate to a simulated medical emergency.	Assess the app's ability to perform point-to-point routing, drive the wrong way on a one-way street, and route selection capability.

Figure 2-2 Emergency Vehicle Navigating between Simulated Barriers

Figure 2-3 First Responders Reviewing QuickRoute's Navigation Options

Figure 2-4 First Responders Navigating to a Road Repair Hazard Alert

QuickRoute After-Action Review Interface

Following the driving circuits, Azimuth1 presented the after-action review interface capability of QuickRoute. This gave the evaluators the opportunity to view the routes taken throughout the OFA. The display included the civilian route, suggested route, and route actually taken, as well as distance and duration of the routes.

Debrief

A debrief session, facilitated by the NUSTL OFA test director, was held at the conclusion of all activities with all OFA participants. During this session, evaluators are encouraged to provide comments to elaborate on their numerical ratings.

Figure 2-5 Data Collectors Gathering Feedback from Evaluators during the Debrief

2.3 Limitations of and Deviations from the Test Plan

2.3.1 Limitations

While QuickRoute is designed to be used for navigation on publicly accessible streets and highways, to conduct a controlled and safe test of a prototype technology the OFA took place at a closed government facility. Mapping detail was not available to the same extent as that for public roadways, and there was little to no other traffic present during the OFA activities, limiting the accurate comparison of travel times for different routes.

2.3.2 Deviations

There were several deviations from the QuickRoute Operational Field Assessment Plan (2019):

Untested Project Requirements

Project requirements that were not available at the time of the OFA could not be tested. The capability to integrate with navigation systems hardwired into the evaluator vehicles and hands-free voice control were not functional for assessment by evaluators at the OFA.

Removal of Civilian Vehicle Type Routing

The test plan called for evaluators to run each identified scenario route twice. The plan stated that the first time they "responded" to the incident, they would do so using the app's civilian vehicle/truck mode; the second time they traveled the identified route, they would do so using the emergency response vehicle/truck mode. This would have been done so evaluators could compare the speediness and efficiency of responses for each of the two routes. During the actual OFA, evaluators only took a screenshot of the outlined civilian vehicle/truck route for each scenario as it appeared in the app, and completed each scenario route only once in emergency vehicle/truck mode. This was deemed necessary to allow sufficient time for each team to complete all 3 circuits, and an acceptable modification since it was not necessary to drive the civilian route to evaluate the app's route comparison capability.

Omission of Android Devices

The test plan stated that evaluators would use the app on both iOS and Android devices during the OFA but evaluators only used iOS devices during the event. This was deemed necessary because the Android devices available at the OFA did not have integrated cellular service, requiring use of paired portable hotspots to connect to the internet in order to run the QuickRoute app; the hotspots were found to have limited connectivity at some points on the routes. Instead, the developer had the Android phone version of the app on a Google Pixel 3 mobile phone where the evaluators confirmed that the functionality was the same between the iOS and the Android version.

Reroute of Circuit A's (Fire) Response Location

The first response location for Circuit A: Fire Response was changed from what was stated in the test plan due to an unanticipated road block at the venue.

3.0 RESULTS

This section contains feedback from the evaluators' responses to questionnaires and group discussions. This includes evaluator suggestions for enhancements to the app and feedback on additional areas for innovation that may improve functionality. It is organized into sections on functionality and reliability followed by specific features of the app.

The questionnaire was structured so that evaluators selected a response of strongly agree, agree, disagree or strongly disagree to a statement and provided comments to explain their selection for each of the three circuits A, B, and C. In some cases, evaluators provided a neutral or not applicable (N/A) response to the statement; a neutral response was given when the evaluator did not have a strong opinion, either way, about the given statement; while an N/A response was given when the evaluator was not able to use a particular feature of QuickRoute due to technical difficulties or non-applicability to a specific circuit. Bar graphs in sections 3.1 to 3.10 illustrate the evaluator responses to the statements for each of the three circuits. The statement posed to the evaluators appears above the graph and the response options are listed on the vertical axis. The number of responses is shown on the horizontal axis, and results are indicated by the length of the bars for each option during Circuits A, B, and C, corresponding to the key at the right of the graph. There is a total of six responses per circuit, one for each evaluator.

3.1 Functionality and Reliability

As shown in Figure 3-1, for circuits A and B two evaluators agreed that QuickRoute was fully functional and performed reliably, while four either disagreed or strongly disagreed. For circuit C, four agreed with this statement, while two felt the main reason the app was not functioning was a lack of cell reception connectivity so they did not give a response (denoted as "neutral").

QuickRoute was fully functional and performed reliably.

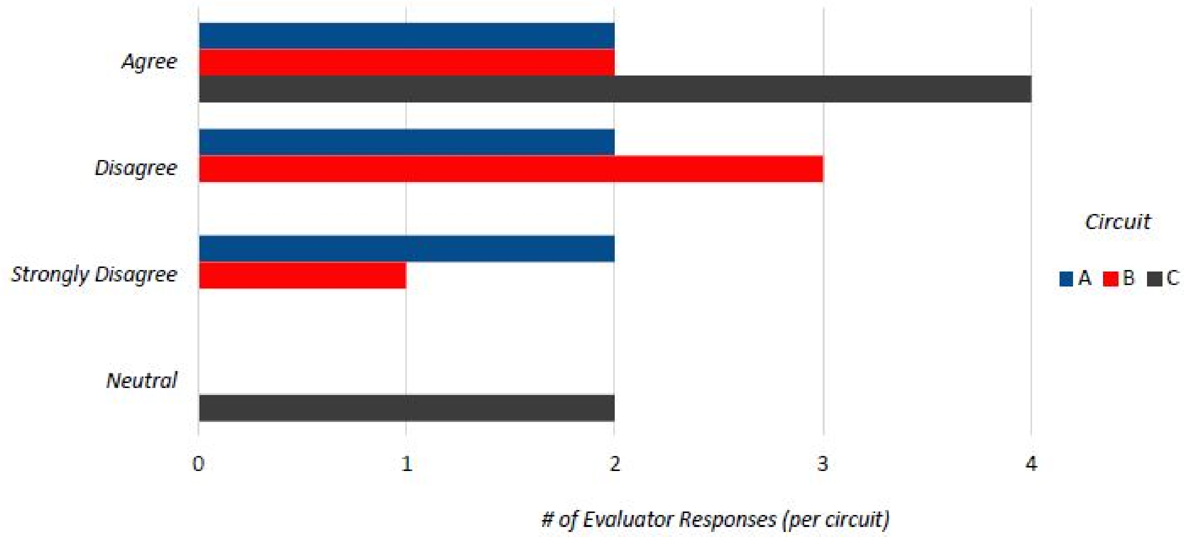

Figure 3-1 QuickRoute Functionality and Reliability

The app crashed numerous times throughout the three circuits with all users having to reboot. Two evaluators still agreed with the statement that the app was functional and reliable because they attributed the problems to the app still being in beta version. There were also latency issues when the app needed to reroute or respond to newly entered data. It was difficult to determine if these problems were due to connectivity issues at the site or the fact that the app developer mapped the site just for this exercise. Additionally, at certain points during the circuits, routing issues, including the app crashing, occurred when the vehicle was in close proximity to alerts on the map leaving some evaluators unable to navigate to the next incident site in a scenario after routing to an existing alert or after creating a new alert in the app. Many of the evaluators felt that despite the added features QuickRoute did not provide more reliability, ease of use, and rapid response than commercially available apps such as Waze and Google Maps. The consensus was that in order for QuickRoute to be the preferred navigational system in an emergency response scenario, the app had to have all the features and reliability of commercially available apps and then incorporate the special permissions and restrictions that emergency vehicles must deal with.

3.1.1 Opportunities for Improvement in Functionality and Reliability

After taking into account connectivity issues, some evaluators still felt the developers needed to improve the design so they could enter alerts in the app more easily, view alerts in a more consumable fashion, solve the issue of the app crashing when vehicles were too close to an alert, integrate into CAD systems, and reduce latency during routing.

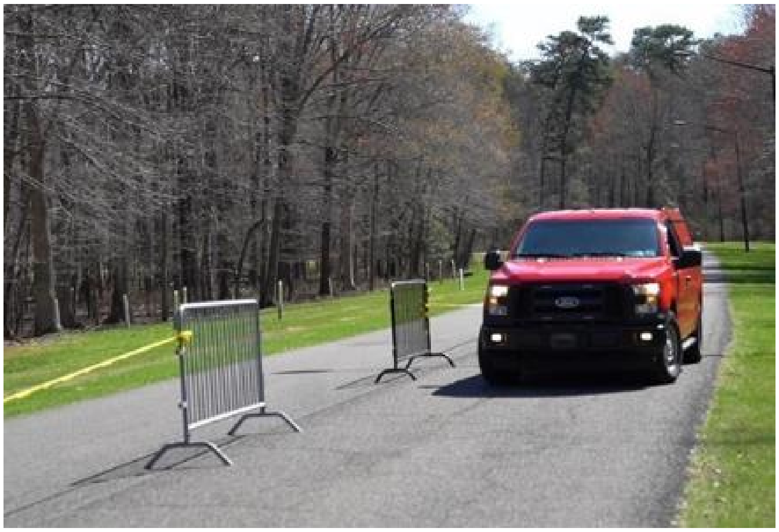

Figure 3-2 Emergency Vehicle about to Cross a Simulated Barrier

All of the evaluators agreed that there needs to be some type of warning when a traffic rule is being broken on the route driven, such as driving the wrong way on a one-way road or crossing a divided highway barrier, as seen in Figure 3-2. They noted that responders need to be made aware when they are disobeying civilian traffic laws during an incident response for safety purposes. This warning should be both visual (on the device) and audible. Similarly, the evaluators felt that a voice command feature should always be available for inputting destinations and providing navigation to an incident. It would be ideal for a responder to tell the app where they need to go and for the app to automatically route them there; when responding to an emergency incident they will not have the time to manually enter the destination.

3.2 Emergency Vehicle Selection

At the beginning of each circuit, evaluators were asked to enter a vehicle type based on the scenario and confirm roadway parameters for the vehicle. Evaluators selected different vehicle types based on each scenario so they could determine the ease of entering and confirming each vehicle type that would be used during a true emergency response situation. During Circuit A, evaluators were asked to select and confirm the "Emergency Truck" vehicle type, while during Circuits B and C they were asked to select "Emergency Vehicle."

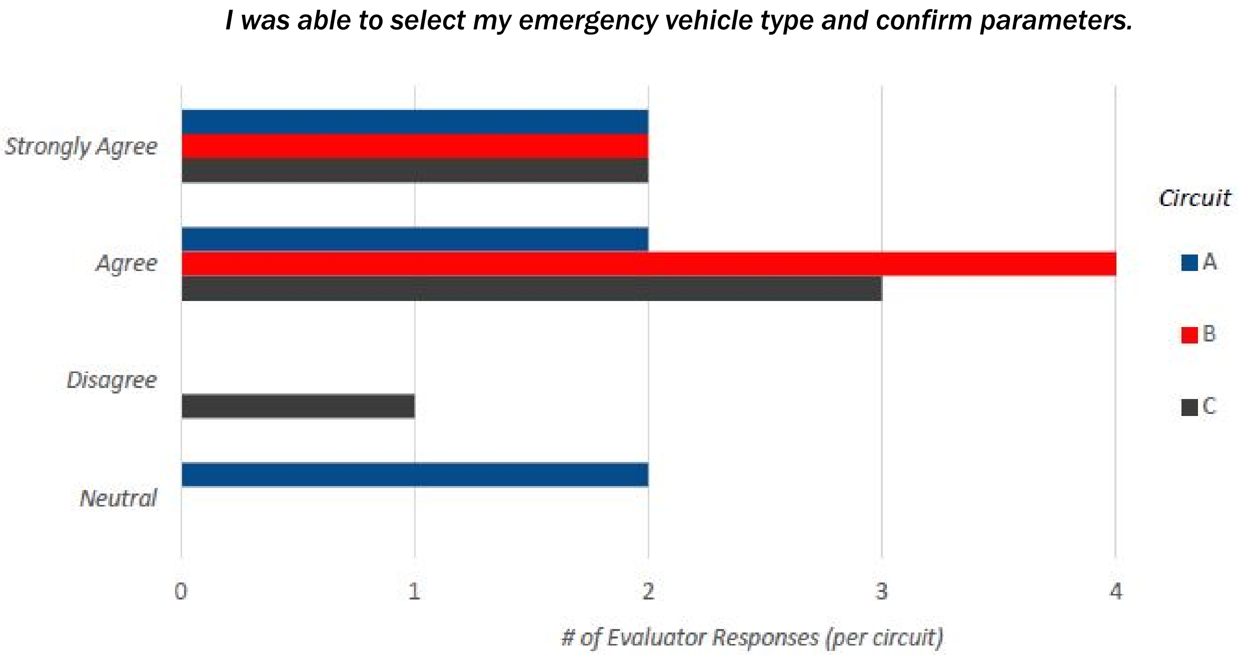

Figure 3-3 Evaluators' Ability to Select Emergency Vehicle Type

The majority of evaluators generally agreed that it was easy and intuitive to select a vehicle type and confirm parameters in QuickRoute, but one evaluator did note during Circuit C, Medical Response, that there were too many steps involved in choosing the vehicle type; they thought the app could be improved if there was less "clicking" and the app minimized touchpoints required to add/confirm vehicle type. These results can be seen in Figure 3-3.

Additionally, two evaluators had a neutral response to this question during their final circuit. They agreed that they could intuitively select the vehicle type and confirm parameters, but noted that there was not a great deal of information available describing the exact features, (size, weight, turning radius) associated with each unique vehicle type within the app. The vehicle selection screen is shown in Figure 3-4.

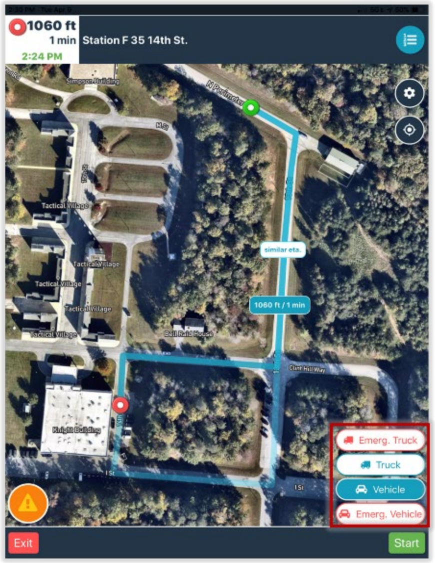

Figure 3-4 Vehicle Selection Area
(In Red Box)

3.2.1 Opportunities for Improvement in Emergency Vehicle Selection

For emergency vehicle selection, the evaluators identified one recommendation: the ability to use customizable settings to create and save customized vehicle types within QuickRoute.

3.3 Incident Location Selection

During each circuit evaluators were asked to select the response destination from a list of locations. Two-thirds of the evaluators agreed that it was easy to select the destination in the app, as displayed in Figure 3-5. One evaluator team noted that the app resembled other commercially available GPS systems thus making selection intuitive.

I was able to easily select the location of the incident.

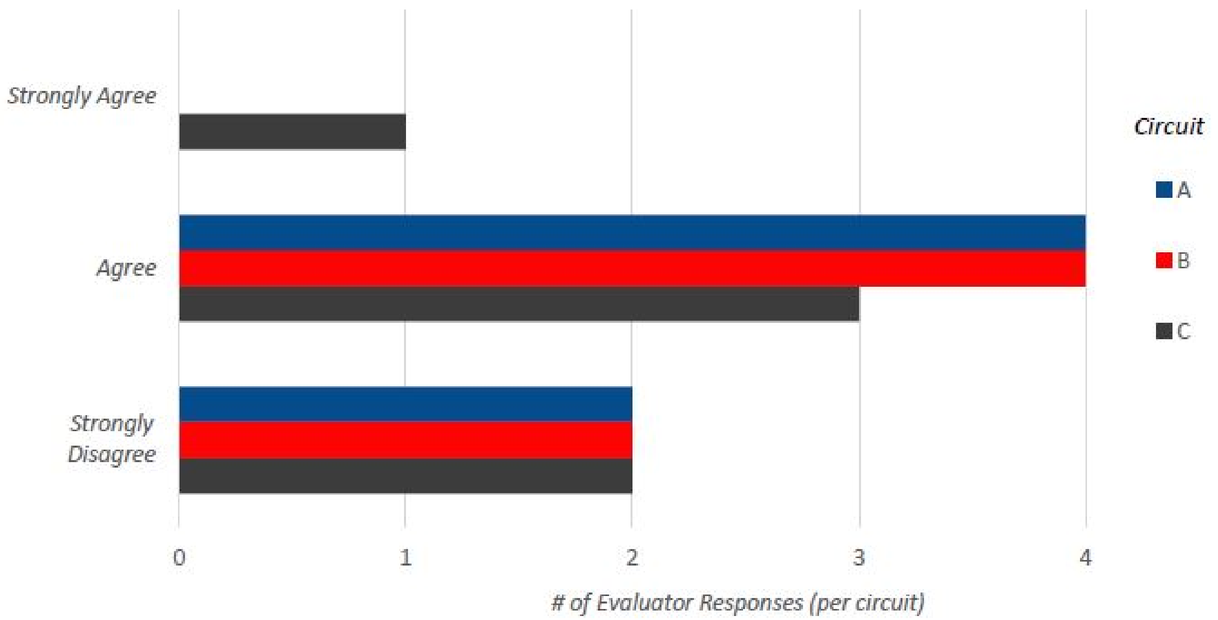

Figure 3-5 Evaluators' Ability to Easily Select Incident Locations

However, two evaluators strongly disagreed that it was easy to select the location in the app. They said that even though choosing a destination from the app's pre-determined list was easy, they were unable to manually select a location on the map in the app by touching the desired map location, which is a capability other evaluators successfully used.

3.4 Confirming and Clearing Hazard Alerts

During Circuit B, Accident Response, and Circuit A, Fire Response, evaluators were asked to confirm and clear emergency and hazard alert notifications within the app. See feedback responses in Figure 3-6.

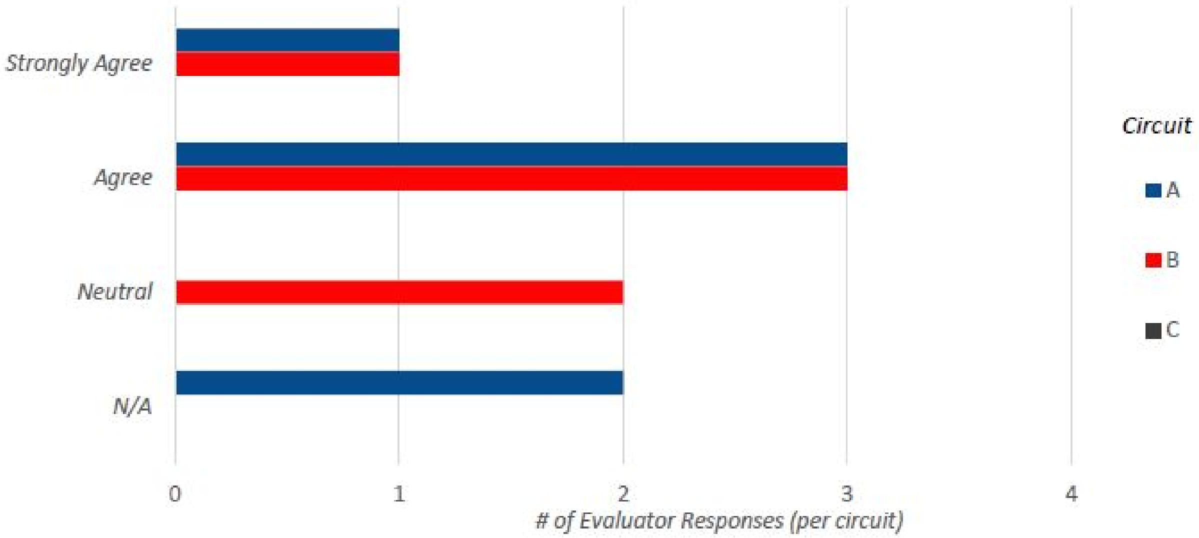

Figure 3-6 Evaluators' Ability to Intuitively Confirm and Clear Alerts
(Two evaluators gave No Response for Circuit A)

The majority of the group agreed that it was easy to do this during both circuits; however, one evaluator recommended that the app enable users to sort and search alerts using filters or some type of customized sorting capabilities. As shown in Figure 3-7, the hazard alerts show when the alert will automatically clear (two hours from the time it is added or confirmed), your distance from the alert, the type of alert along with the corresponding icon, and the confirm and clear buttons. Clearing the hazard alert will immediately remove it from the QuickRoute displays and confirming the hazard alert will extend its active status by two hours.

One evaluator team had a neutral response to this statement during Circuit B, as they had to refresh the app before confirming and clearing an alert. Therefore, even though they could confirm/clear an alert once it appeared, they were unable to do so in real-time. Evaluators explained that this app delay would be unacceptable during an emergency response scenario. During Circuit A, this team agreed that it was easy to confirm/clear an alert on the iPad but disagreed that this was easy on the iPhone that they were simultaneously using to complete the circuit. Furthermore, the evaluator using the iPhone had an issue confirming the alerts listed on the bottom of the app's alert display, as QuickRoute would not let him scroll all the way down to clear the alert. This variance in functionality on different devices suggested that the app might have different technical glitches based on which type of device a user routes from.

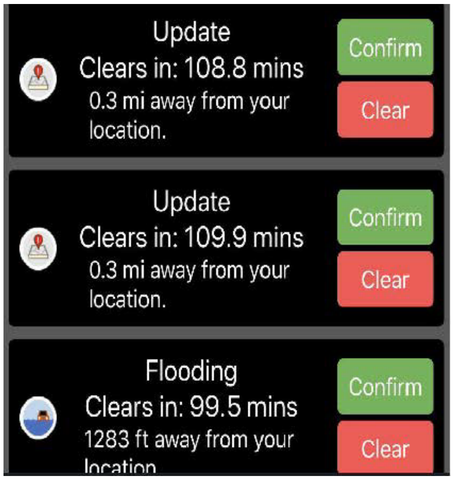

Figure 3-7 Confirming and Clearing Functions

3.5 Efficient Emergency Routing Compared to a Civilian Route

During each circuit, the evaluators were tasked with selecting a predetermined location in the app in order to route to the incident site. Once the evaluators were dispatched and the location of the incident was selected in the app, they were instructed by the data collector to toggle between vehicle types in order to visually see the similarities or differences between the possible routes provided for the emergency and civilian vehicles (screenshots were taken of the two routes for comparison later), as seen in Figure 3-8. After each circuit was completed the evaluators assessed the emergency vehicle route's efficiency, primarily taking into account time and roadway restrictions depending on the vehicle's parameters. The white box on the civilian vehicle screenshot provides information comparing the eta for the two routes.

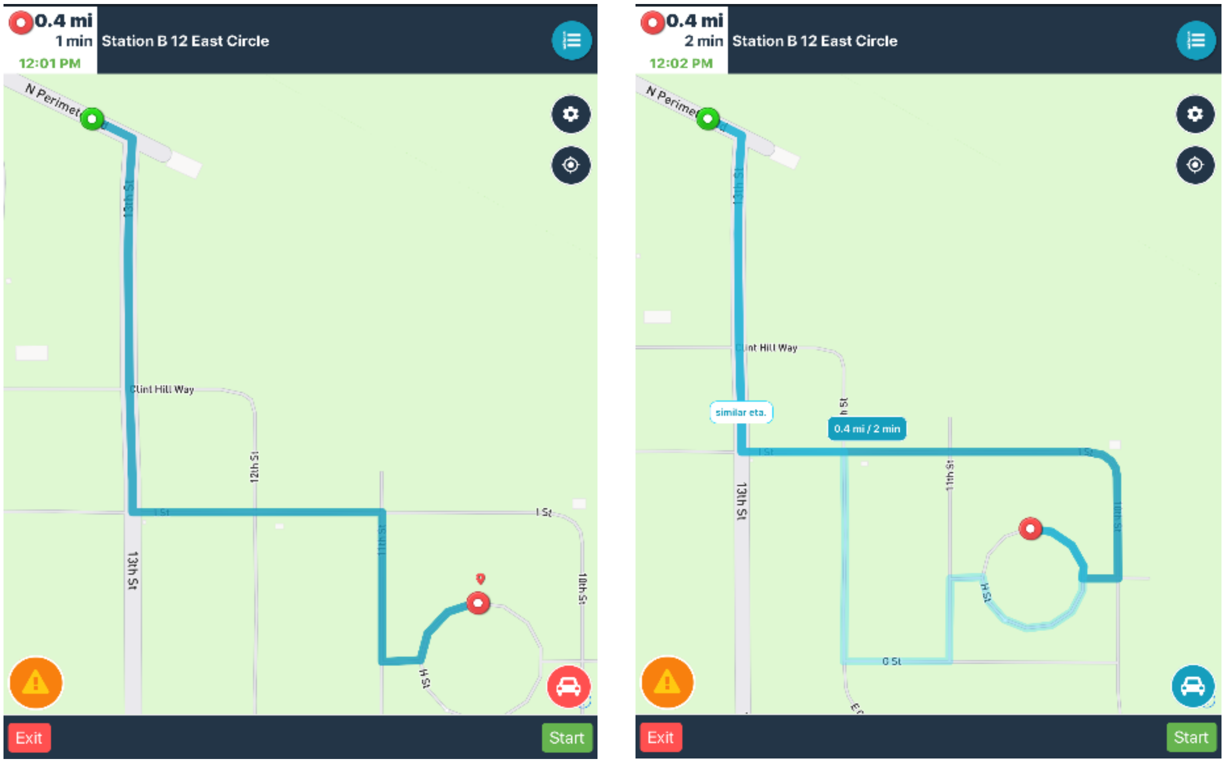

Figure 3-8 One-Way Traffic Circle Routing: Emergency Vehicle (Left), Civilian Vehicle (Right)

As shown by Figure 3-9, the majority of responders agreed that the route provided allowed them to respond to the incident efficiently compared to the civilian vehicle route that was displayed during all three circuits. Note that during Circuits A and B, two evaluators did not provide a response to this statement because they felt they could not draw a comparison between the emergency and civilian routes provided, as they were the same.

The route provided allowed me to respond to the incident efficiently compared to the non-emergency vehicle route.

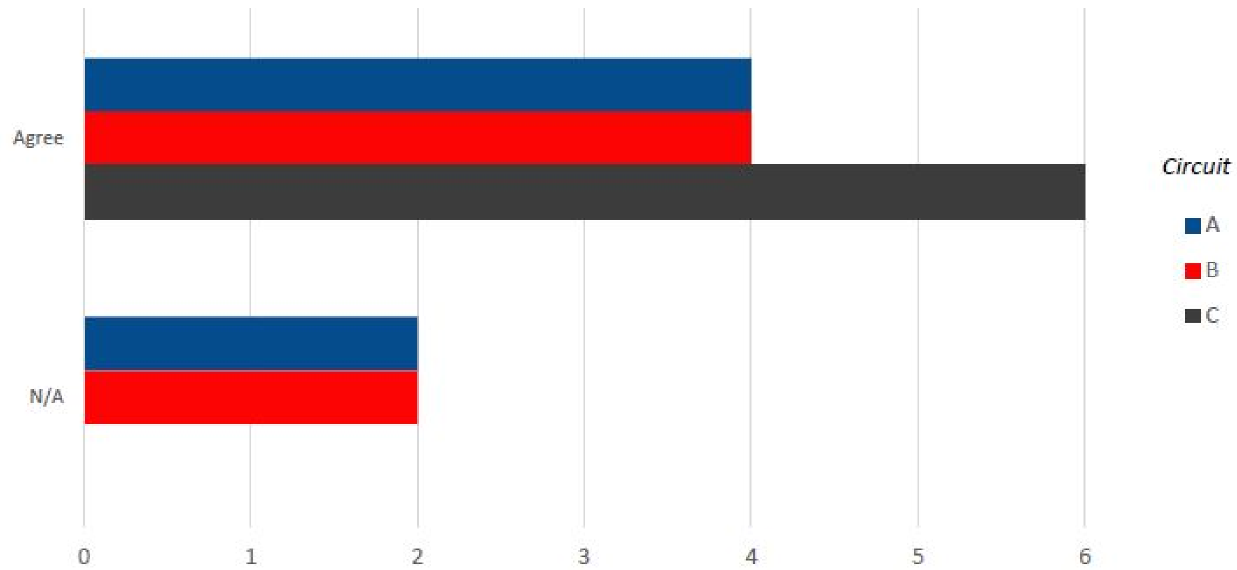

Figure 3-9 QuickRoute Provided Emergency Vehicles a More Efficient Route
(Two evaluators gave no response for circuits A and B)

These results show that throughout the event the evaluators were mostly able to successfully route to the incident site efficiently compared to a civilian vehicle route. One team of evaluators specifically pointed out that they were able to see a demonstrable difference in the routes that the app displayed for civilian verses emergency vehicles during Circuit C, and they were successfully routed to avoid the two alerts that existed on the map at the time. They said that having multiple route options displayed is important to responders during a true incident response.

3.5.1 Opportunities for Improvement in Efficient Emergency Routing Compared to a Civilian Route

Evaluators stated that it would be nice to see some sort of justification as to why a specific route was chosen. Another team of evaluators suggested that including the road surface type could increase navigational efficiency by comparing the parameters of the vehicle to the surface on which it is supposed to drive.

3.6 Ability to Understand and Follow Routes

The majority of evaluators agreed that the display of the route on the map was easy to understand and follow during the assessment, as can be seen in Figure 3-10. Note that two evaluators did not provide a response to this statement for Circuit A. At various times throughout the OFA, some evaluators felt that the quality of the display of the routes was poor and provided suggestions for improvement. Two evaluators noted that sometimes the app had trouble telling the direction that the car was facing and it was difficult to see the directions.

The display of the route on the map was easy to understand and follow during the circuit.

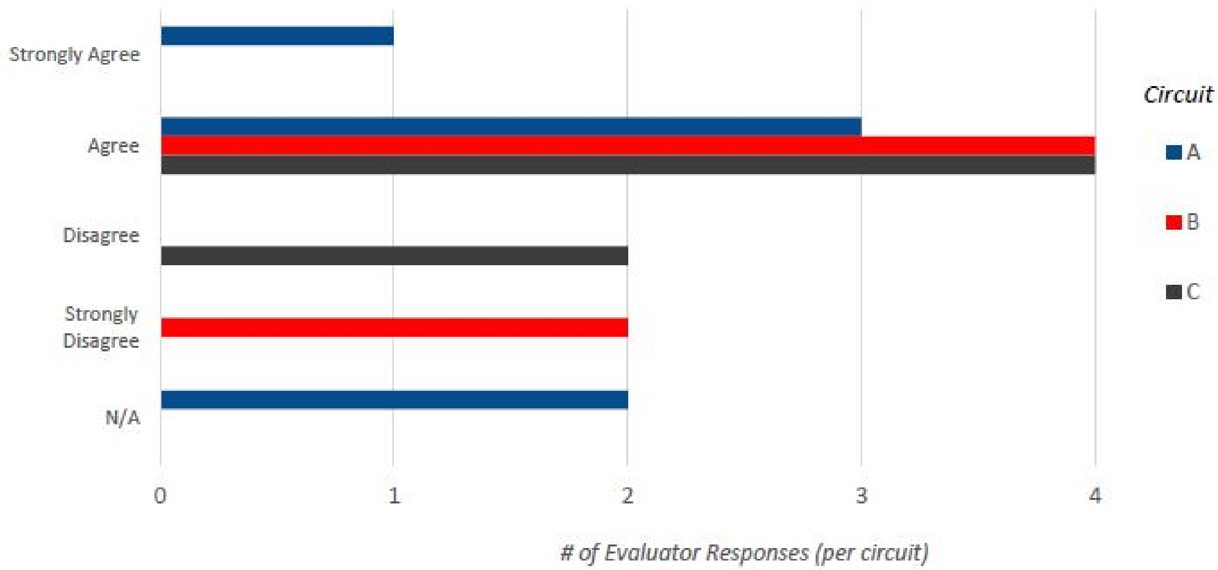

Figure 3-10 The Route Displayed was Intuitive
(Two evaluators gave no response for circuit A)

Additionally, the evaluators expressed concern over the scope of the map view during routing. Multiple evaluation teams felt the map was too zoomed in on the location of the vehicle and would have preferred a more zoomed out view of the map. A broader view of the map would allow for a better visual cue of an upcoming turn/instruction. One pair of evaluators also felt that the way in which the route progressed was not as instantaneous as they hoped. In one instance, there was a turn that seemed like it would have saved them time; however, the app did not notify them quickly enough to take the earlier more efficient turn. The evaluators could not determine if this was due to an overall performance issue with the app or to the navigational limits of the closed driving course.

An issue multiple evaluator teams experienced was what appeared to be the app's inability to decipher the directional orientation of the vehicle. At certain times it did not necessarily pick up on the direction the vehicle was facing and would instruct the driver to turn around instead of continuing in the same direction as the original route.

3.7 Rerouting Viability

During the simulated emergency response in Circuit B, the evaluators were instructed to purposely deviate from the recommended route in order to observe how the app automatically rerouted them to the incident site. This was the only scenario during the assessment in which the evaluators were instructed to purposely make a wrong turn. The app did not seem to perform as expected. All six evaluators disagreed that they were rerouted to a viable route after the wrong turn was made.

Each evaluator team experienced similar issues when the app attempted to reroute them to their desired location. Overall, there were latency issues when evaluators missed a turn that was indicated on the app. The vehicles were not automatically rerouted quickly enough, which led to inefficient routing. For the most part, the app either instructed the vehicle to make a U-turn or take a turn that the vehicle was already passing. Two evaluators felt this was a key issue for the developers to fix because, “the second a missed turn happens and the vehicle is not immediately rerouted, responders will drop the app and use something else for navigation.” Some evaluators thought this issue may have been attributed to the closed driving course that had to be created from scratch in the app but they reiterated that QuickRoute needs to be 100 percent functional and reliable at all times for responders to use it.

QuickRoute did not seem to take into account or prioritize the turn radius of emergency vehicles; an issue throughout the assessment was the rerouting of vehicles by way of U-turns. The app instructed the emergency vehicles to turn around at seemingly no cost to the estimated time of arrival, which would not be the case in a real-world scenario with larger vehicles.

3.7.1 Opportunities for Improving Routing Viability

Evaluators had the following recommendations to improve the app’s routing functions:

- Do away with the “Pause” and “Exit” buttons, as shown in Figure 3-11; the app should automatically end the route upon arrival as commercial navigation apps currently do.

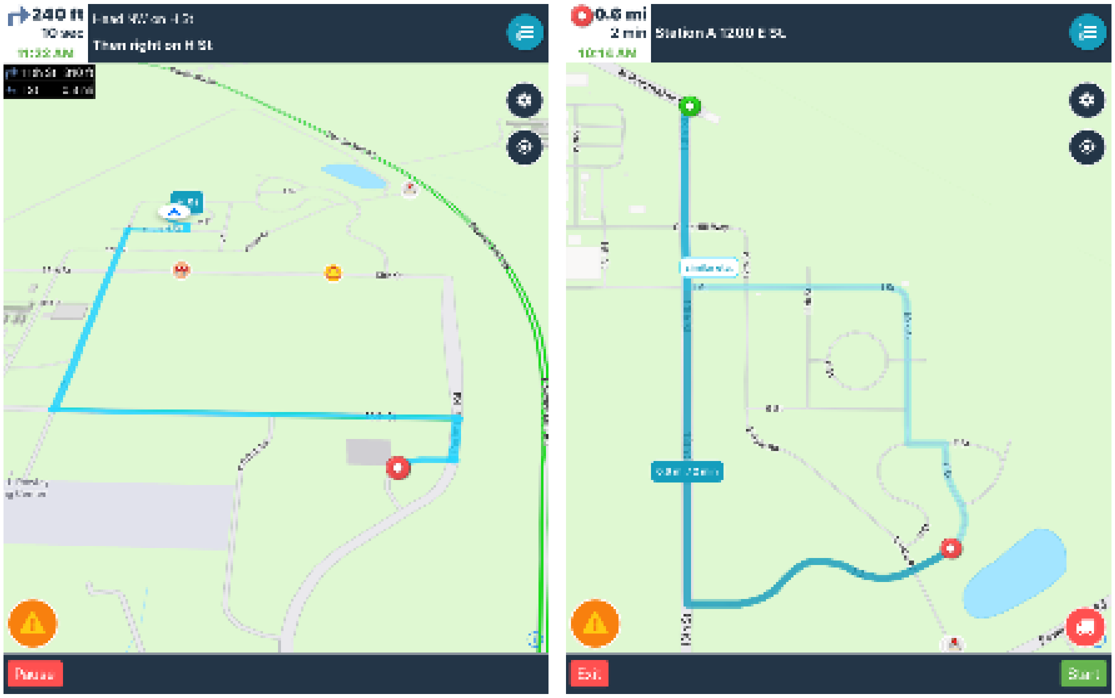

Figure 3-11 End of Route “Pause” and “Exit” Buttons

- Include road type data to increase navigational efficiency (i.e., a firetruck may be unable to navigate on a dirt road based on its size and/or the weather conditions).

- Incorporate road closure and road work alerts into the app.

- Include the ability to route directly to hazards instead of having to manually select a location near the hazard and route to the site.

3.8 Entering Hazard Alerts

During Circuits A and B, evaluators were asked to enter hazard alerts using QuickRoute to identify simulated flooding and a car accident. The majority of the evaluators agreed that the process of entering a hazard alert was intuitive, quick and therefore would not have an impact on their response to an incident. Those evaluators that strongly disagreed said that they were not able to efficiently enter or see alerts.

These results are shown in Figure 3-12. Note that entry of a hazard alert was not an activity identified for Circuit C, so there are no results reported for that circuit.

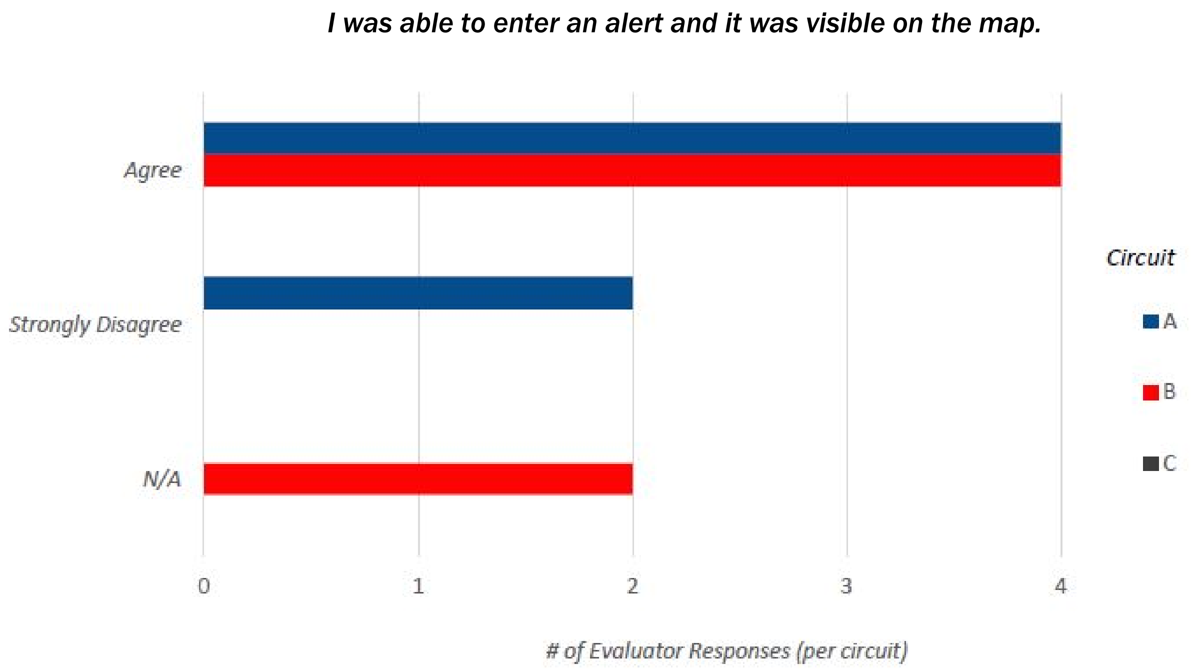

Figure 3-12 Ability of Evaluators to Enter an Alert and See it on the Map
(Two evaluators gave no response for circuit B)

3.9 New Hazard Alert Display

During all three circuits, a radio message from dispatch identified various hazards, including simulated flooding, an accident, road repair, and a general hazard, at predetermined times to a specific vehicle.

These corresponded to marked locations that the vehicle would encounter along their current route. In response, one of the three teams would enter the hazard alert at the pre-identified location. Figure 3-13 shows the screen when a new alert notification is received.

The other evaluator teams were then asked if the new hazard alerts were visible on their maps as they were added. Their responses ranged from agree to disagree and strongly disagree, as shown in Figure 3-15. Note that during Circuit C one team responded Not Applicable as no new alerts had been added prior to them completing their circuit.

One team of evaluators agreed that they were able to see the hazard alerts as they were added, but it was difficult to distinguish between new alerts and existing alerts when there were several displayed simultaneously in a cluster, shown in Figure 3-14.

The evaluators who disagreed had various reasons for doing so. During Circuit B, one team indicated that QuickRoute had crashed and had to be rebooted in order to be functional and display newly added hazard alerts. It is possible that this was due to connectivity issues in a specific area of the venue. During Circuit A, another team had to restart the app in order to see hazard alerts displayed. Those that disagreed indicated that limiting icons and simplifying the hazard alert display would make it easier to see new alerts in the app. Evaluators who strongly disagreed indicated that the process of seeing a hazard alert was cumbersome and not instantaneous. The hazard alerts did not automatically refresh and the evaluators continued to state that first responders do not have time to refresh the app and wait for information to be downloaded when responding to a critical incident in real time.

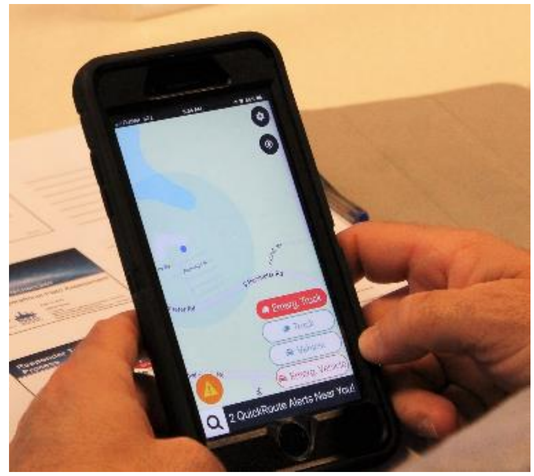

Figure 3-13 An Evaluator Observing Alert Notifications

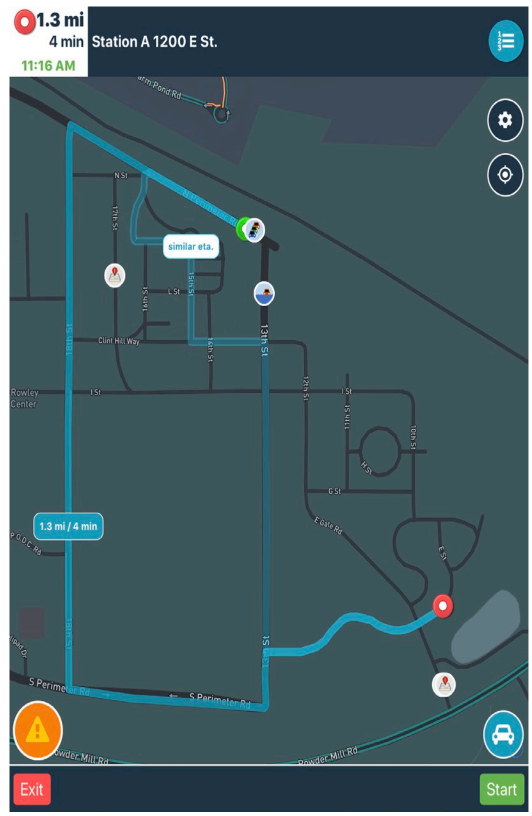

Figure 3-14 Hazard Alert Icons Displayed during Routing
(Circled in Red)

I was able to see new alerts on the map as they were added.

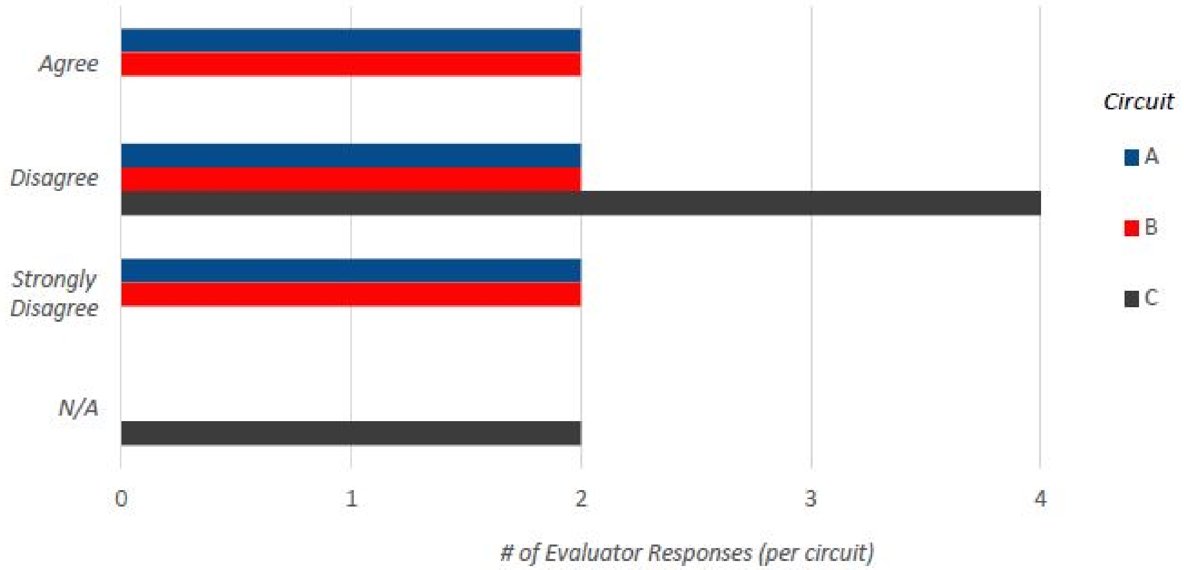

Figure 3-15 Ability of Evaluators to See New Alerts as Added
(Two evaluators gave no response for circuit B)

3.9.1 Opportunities for Improvement with New Hazard Alert Display

Evaluators provided recommendations to enhance the hazard alert capabilities of the app:

- Color-coding hazard alerts to advise the first responders if the hazard is safely approachable or passable.
- Customization capabilities for the general hazard alert, which displays as "hazard," so further details can be included, ideally a note section to type incident specific details.
- A blinking feature for new hazard alerts so that it can catch the attention of the first responder.
- Audible alerts to notify a first responder that they are nearing a hazard alert (either voice or an alarm would be sufficient).
- Simplification of how alerts are displayed, only portraying the level or hazard and most critical information.
- Customized sorting capabilities for users to filter different hazards and alerts based on critical response needs so they can easily view these items when responding in an emergency situation.

3.10 Confirming and Clearing Existing Hazard Alerts

During Circuits A and B, evaluators were asked to confirm or clear hazard alerts that were previously entered both by evaluators and dispatch. The majority of the evaluators either strongly agreed or agreed that they were able to confirm and/or clear existing alerts, while two evaluators said that this was not applicable to them as they indicated that they were not able to properly evaluate this activity since they had to refresh the app prior to confirming the alert. This is displayed in Figure 3-16. Some of the evaluators strongly agreed and stated that the confirm and clear processes were reasonably intuitive. Those that agreed concurred that the process was intuitive, but they would have preferred to have an audible cue indicating arrival at the hazard alert.

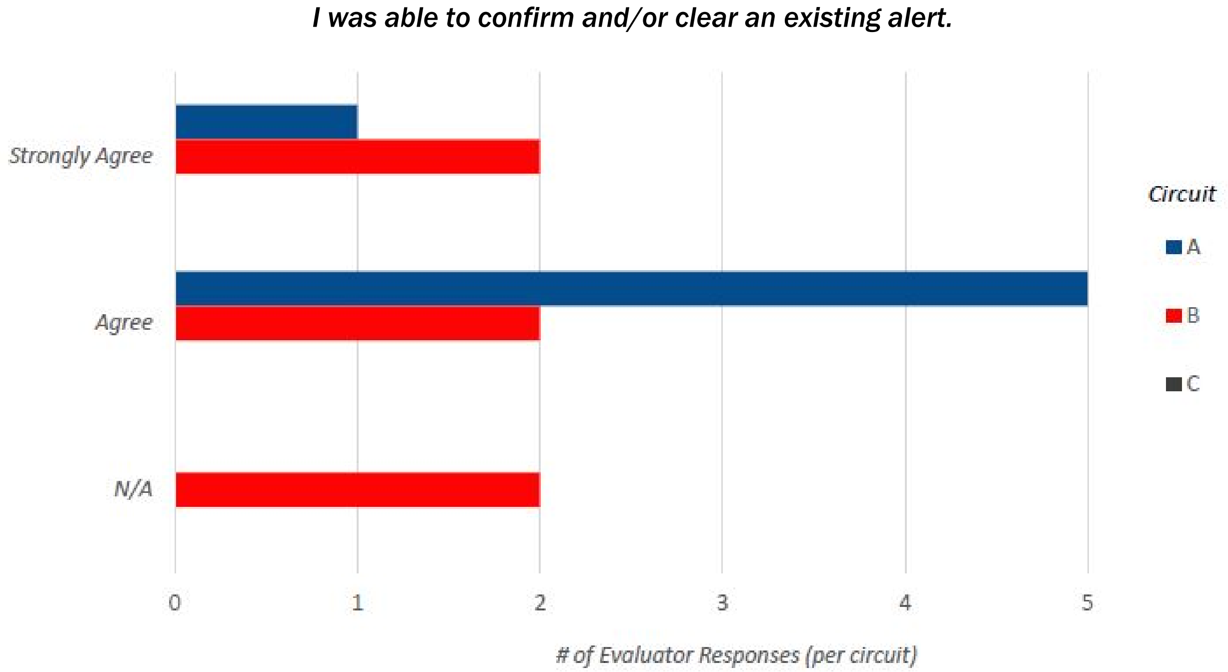

Figure 3-16 Ability of Evaluators to Confirm/Clear Existing Alerts
(Two evaluators gave no response for circuit B)

3.11 Overall Experience Feedback

Following the completion of all circuits, the evaluators reconvened and provided general feedback on their overall impressions of the QuickRoute app throughout the duration of the day. There was a difference of opinion on QuickRoute's overall functionality and reliability. Two evaluators agreed that the app was functional and reliable, but identified problems QuickRoute had in understanding the direction a vehicle was moving. Since there were no audio or verbal cues to signal evaluators, they also had difficulties seeing new hazards entered on the map. The other four evaluators felt that the app was neither functional nor reliable when tested during the OFA (two disagreed and two strongly disagreed). They noted that the problems may have been due to lack of connectivity and the lack of mapping details affiliated with the routes at the test site. However, there were other issues with routing and the app's alert notification system that need to be corrected.

They stated that ultimately QuickRoute must have at least the functionality and speed of commercially available navigation apps to be considered for use within the first responder community.

Feedback based on overall experience regarding QuickRoute's user interface, display, required training, and after-action usage reports is summarized in the column graph in Figure 3-17, and discussed in detail in following sections. In Figure 3-17, four questionnaire statements posed to the evaluators are shown on the horizontal axis; the height of each bar represents the number of evaluator responses of strongly agree, agree, disagree, strongly disagree, and N/A (blue, light blue, red, orange and grey, respectively). Each of the four statements has six total responses corresponding to each evaluator.

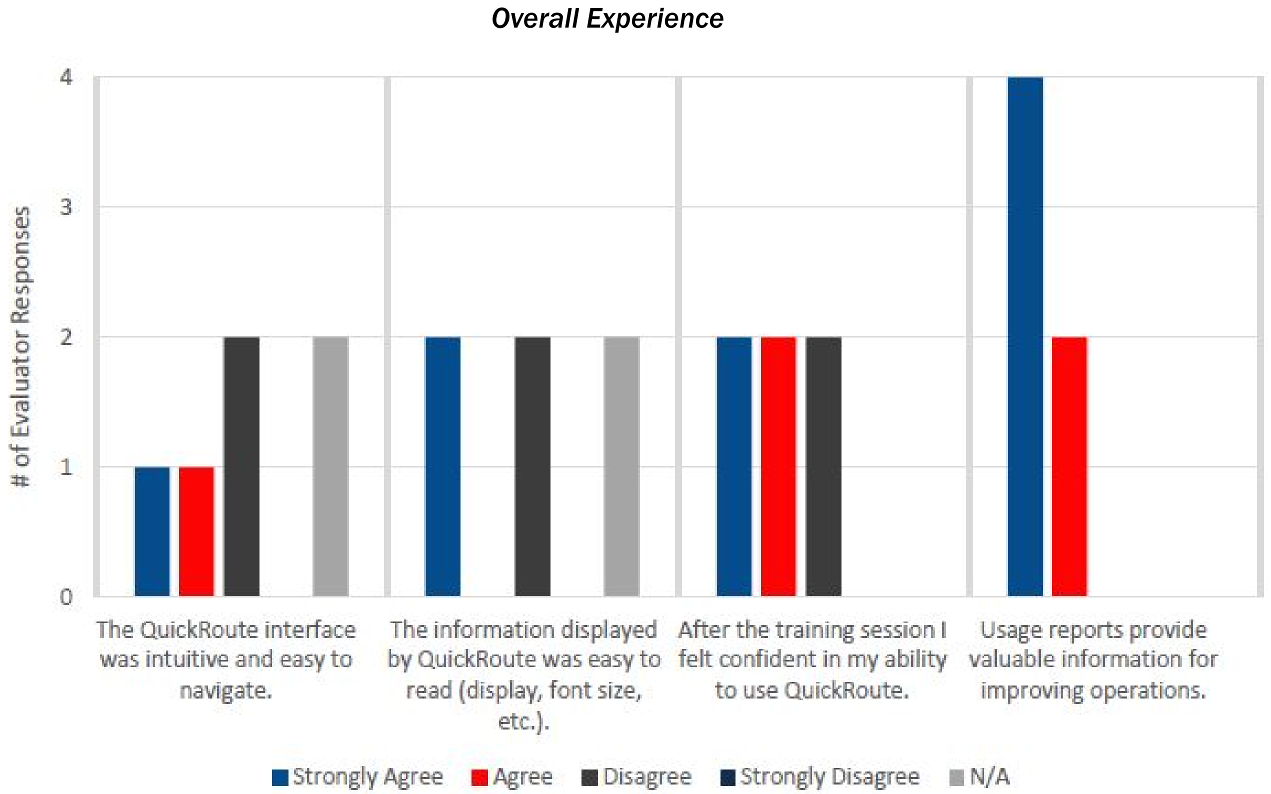

Figure 3-17 Evaluators Overall Experience

3.11.1 User Interface

Evaluators' feedback varied on the intuitiveness of working with the app's user interface. One team agreed that the app was intuitive and easy to use and reported that they had no issues with its interface or button size. While this team would have liked QuickRoute to minimize clicks and touchpoints and have a horizontal display view, they ultimately believed that app usability among users would improve with training and frequent use. The remaining two teams did not believe the QuickRoute interface was intuitive or easy to work with.

These evaluators also cited the need for QuickRoute to minimize app touchpoints, but unlike the above group of evaluators, these teams found it would likely inhibit using the app in an emergency response scenario.

As previously mentioned, all evaluators expressed a desire to have voice integration options to make it easier to quickly route to a destination and confirm parameters and requirements within the app. They also wanted to see customizable aspects of functionality that were not currently in the app, such as being able to save key locations.

Figure 3-18 First Responder Utilizing QuickRoute during a Circuit

3.11.2 Information Displayed was Easy to Read

Again, the evaluator teams were split in their feedback on how easy it was to read information that was displayed. Two-thirds of the evaluators disagreed that information was easy to read, while one-third agreed. Those that agreed were strong in their response and said that QuickRoute's satellite map was a nice additional feature within the app and very useful for emergency response situations. Evaluators that disagreed explained that the text within the app was too small to be easily read. One evaluator explained that while he liked that the local time was displayed in the top corner of the app, local time needs to update on the minute within the app itself, and there can be no delay in displaying accurate arrival times.

Finally, evaluators explained that it is critical for them to see all local hazards/alerts clearly displayed simultaneously on the map, and they need to know when they were disobeying civilian road rules for safety purposes (for example, driving the wrong way down a divided highway). It would be extremely helpful for users to have the ability to click on an alert in the alert toolbar, which would then automatically go to where the alert/hazard was physically located on the app's map. Evaluators were unable to see these types of markings clearly or largely enough in QuickRoute during the circuits. Ultimately, the evaluators thought it would be most useful for the app to use both audio and visual warning indicators anytime a new hazard or alert popped up on the map or whenever they were disobeying civilian traffic rules.

These evaluators also wanted to have additional visual map display options so users could pick their preferred display. Though they appreciated that the app displayed upcoming turns, they again wanted customizing capabilities such as having the ability to manipulate the timing of when QuickRoute displayed upcoming turns or directional cues to the user. These evaluators also had issues with how certain things were displayed, such as having a "start" versus "exit" button on a pause screen, and they wanted to see an "arrived" alert when they reached their destination. Furthermore, one evaluator noted that the chosen vehicle type needs to be visible on the app while it routes the user to his/her destination.

3.11.3 Training Was Sufficient for Use of QuickRoute

The majority of evaluators either agreed or strongly agreed that QuickRoute training was sufficient, and one of these individuals said that 24-hour, real-time training with the developer or a subject matter expert would be the best training option. However, two evaluators disagreed with this, and said that they would prefer a more comprehensive training session with further instructions and details. These evaluators said it would be beneficial for the trainers to provide screenshots of the content they train on in real-time during the session. Furthermore, they felt that more interactive scenario-based training would be beneficial to users.

Figure 3-19 Azimuth1 Conducting a QuickRoute Familiarization Session

3.11.4 Usage Reports Provide Valuable Information for Improving Operations

All evaluators either agreed or strongly agreed that usage reports would provide valuable information for improving operations. Evaluators explained that this type of data would be valuable to both administrative and operational personnel, and could be used during debriefing sessions and in after-action reports. Currently, responders can only gather timing related data following an emergency response, so having a comprehensive usage report could help improve response expediency and business operations in the future.

3.12 General Enhancement Feedback

Throughout the assessment, evaluators also provided suggestions for expanded capabilities, enhancements to the user experience, and incorporating additional datasets that could lead to more informed routing.

3.12.1 Expanded Capabilities

- Increase notification time of next navigation step. Ideally, the app should be configurable, allowing you to decide the distance before you are notified of the next turn.
- Add blinking capabilities for new hazard alerts to catch the attention of first responders.
- Provide capability for command center to preselect vehicle type so responders do not have to worry about entering this data when responding in an emergency situation.
- Provide users with the capability to move alerts and response locations on the map as needed to notify fellow responders of exact incident locations. Responders will often receive a call to report to an incident at a certain geographic location, but the true emergency is across the street or in a specific part of a larger building. If they have the ability to manipulate the response location within QuickRoute, it would be easier for back-up response teams to quickly and precisely locate the emergency.
- Responders want to see multiple route options displayed on the map.
- There should be a way to set and lock permissions by commanding officers.

3.12.2 Enhance User Experience

- Minimize touchpoints during use.
- Increase font size.
- It is important for responders to be able to easily see if they are in civilian or emergency mode within the app.
- Some evaluators would like the display to transition automatically between day and night maps instead of the user needing to manually toggle between them.
- Integrate with vehicle plug-in systems (i.e., Apple CarPlay).

3.12.3 Expand Data Inputs

- Incorporate pedestrian traffic data for heavily congested public areas, such as school zones, including speed limit restrictions in these areas. This type of data is already available in some commercial products, and QuickRoute should offer everything that is commercially available along with additional data, functionality, and capabilities.
- Determine if it is possible to integrate state and local Department of Transportation data in real-time with the app so that alerts and hazards identified by state and local governments appear on QuickRoute's map instantaneously.
- QuickRoute should take into account the speed of the roadway.
- Some evaluators suggested having an overlay of hydrant maps for fire response and the status of hospitals accepting patients.
- The app should take into account road types (i.e., dirt, rock) and traffic calming devices (speed bumps).
- Incorporating weather patterns and warnings would be useful.

4.0 CONCLUSIONS

The objective of the OFA was to obtain responder feedback on QuickRoute's functionality, reliability, usability, routing, and hazard alert functions. For QuickRoute to be a major improvement in functionality and reliability over what is presently used it would have to be integrated into existing CAD systems and utilize voice activated routing commands to quickly enter in a response location as first responders may not have time to manually enter addresses into the app during emergency response operations.

QuickRoute's usability of could be improved if there was a reduction in the number of screen touches needed to carry out functions such as choosing vehicle type, entering response locations, and inserting and clearing alerts. Most evaluators felt the font size should be increased and the way the map is viewed needs to be more customizable. There was an issue with lag time during some of the scenarios; it was not clear if this was due to connectivity issues, mapping data at the test site or an issue with the app's functionality. Additionally, the evaluators would like to be able to customize their map view so that they could select ranges of view.

Routing was impeded when QuickRoute did not know which direction a vehicle was facing, suggesting turnarounds that would add travel time, especially for large vehicles, and did not take into account how the turn radius of emergency vehicles would cause delays when rerouting of vehicles by way of U-turns. The evaluators emphasized that safety is of the upmost importance to first responders and they felt that the app should provide clear audio and visual warnings when a vehicle was being directed to circumvent traffic laws. While the evaluators had some recommendations on how to improve the app's hazard and alert notification capabilities, they found the process of entering, confirming, and clearing alerts was generally easy and intuitive.

The evaluators felt that a fully functional QuickRoute would allow them to navigate to emergency scenes more quickly. By combining the speed and functionality of commercially available navigation apps with the special limitations and advantages that emergency vehicles possess, first responders would have a more efficient way to reach an incident if the issues identified during the OFA were corrected.

5.0 REFERENCES

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